

Joint Research Centre (JRC)

The Nucleonica Gamma Library

presented by Jozsef Zsigrai



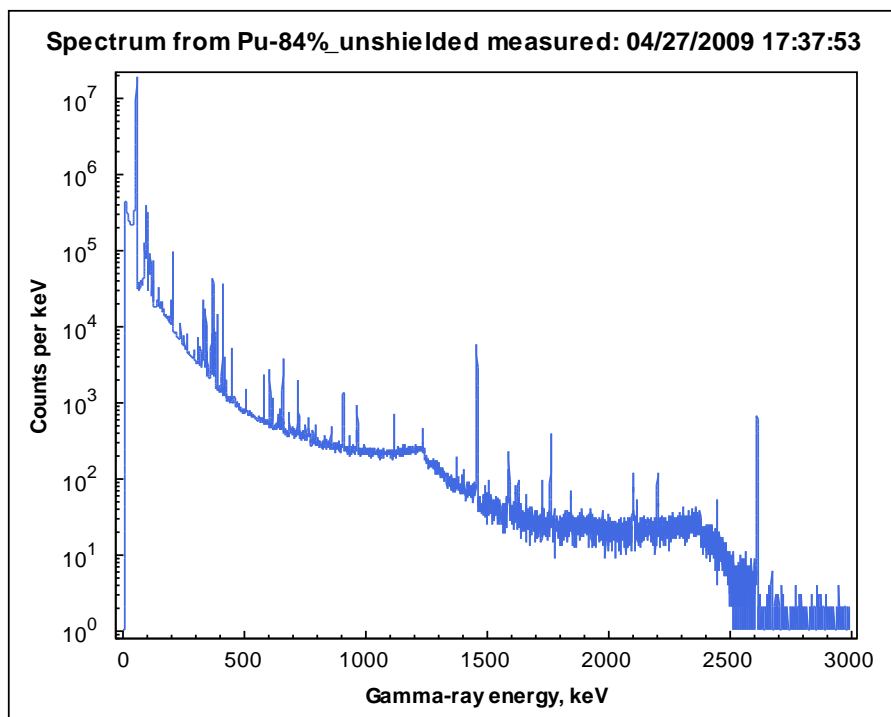
ITU - Institute for Transuranium Elements

Karlsruhe - Germany

<http://itu.jrc.ec.europa.eu/>

<http://www.jrc.ec.europa.eu/>

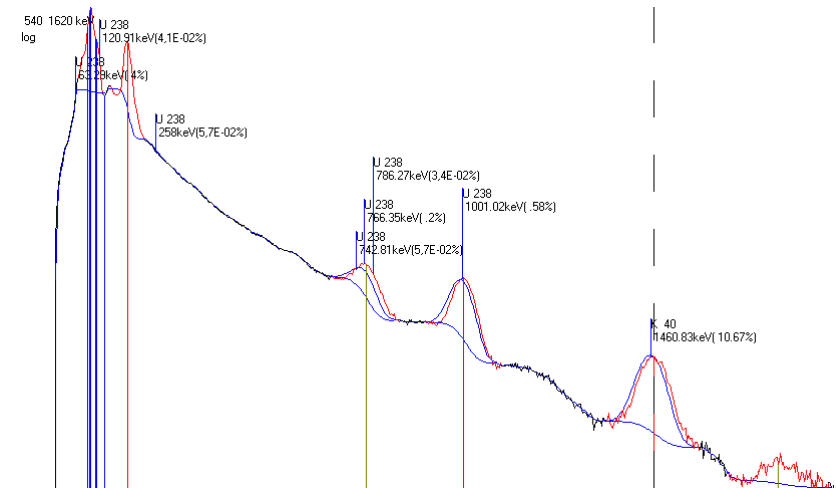
- Each gamma-emitting isotope emits photons with a unique set of gamma energies (“gamma signature” or “fingerprint”)



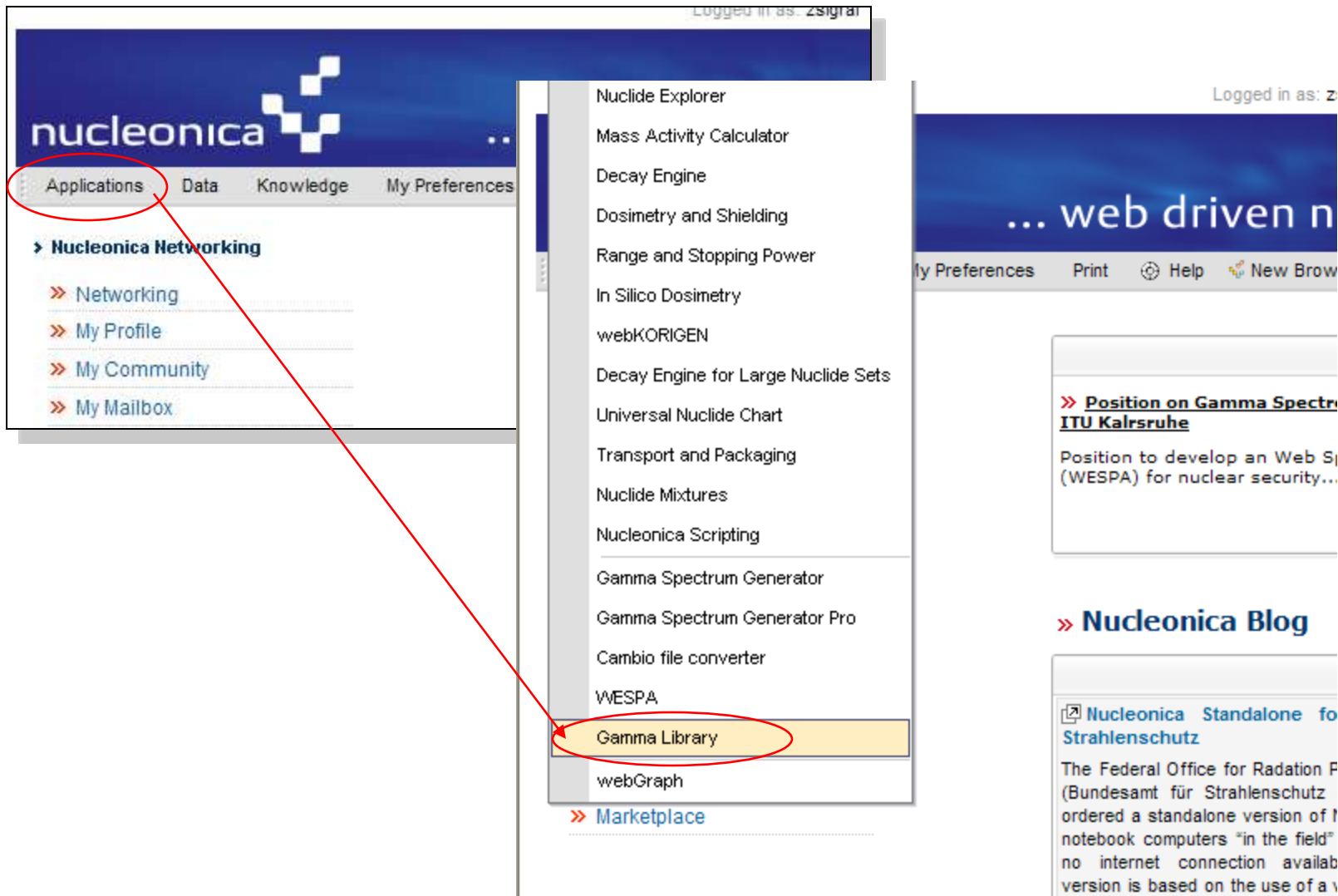
A gamma library is a set of gamma energies with corresponding emission probabilities, emitted by one or more isotopes

Spectrum of Pu, with 84 % of ^{239}Pu

- Gamma-spectrometric software codes use **libraries to identify peaks** in the spectrum
- The Nucleonica gamma library module serves to **create customized gamma libraries** in an easy way
- The created libraries can be **downloaded to PC** (currently two formats are supported):
 - ORTEC Gammavision
 - Identify (WESPA)



ID	Name	Date Modified	Download	Delete
	<i>(Create a new Library)</i>			
22	Np	10.05.2011, 09:54:09		
42	Gotcu-AmPu02	03.03.2011, 08:58:22		
23	U-Age-U232	15.02.2011, 14:47:56		
21	Am, Pu	18.01.2011, 10:50:38		
19	Am-241	18.01.2011, 10:21:57		
66	Calibration Sources	19.08.2010, 13:13:31		
67	Medical Library	08.07.2010, 16:15:27		
Total:	7	Page 1 / 1		



The screenshot displays the Nucleonica web application interface. The top navigation bar includes 'Applications', 'Data', 'Knowledge', and 'My Preferences'. The 'Applications' menu is open, listing various tools such as 'Nuclide Explorer', 'Mass Activity Calculator', 'Decay Engine', 'Dosimetry and Shielding', 'Range and Stopping Power', 'In Silico Dosimetry', 'webKORIGEN', 'Decay Engine for Large Nuclide Sets', 'Universal Nuclide Chart', 'Transport and Packaging', 'Nuclide Mixtures', 'Nucleonica Scripting', 'Gamma Spectrum Generator', 'Gamma Spectrum Generator Pro', 'Cambio file converter', 'WESPA', 'Gamma Library', and 'webGraph'. The 'Gamma Library' option is highlighted with a red circle. A red arrow points from the 'Applications' tab to this circle. Below the menu, there is a 'Marketplace' link. On the right side of the interface, there is a section titled 'Position on Gamma Spectroscopy' and another titled 'Nucleonica Blog'.

Logged in as: zsigra

nucleonica

Applications Data Knowledge My Preferences

» Nucleonica Networking

- » Networking
- » My Profile
- » My Community
- » My Mailbox

Nuclide Explorer

Mass Activity Calculator

Decay Engine

Dosimetry and Shielding

Range and Stopping Power

In Silico Dosimetry

webKORIGEN

Decay Engine for Large Nuclide Sets

Universal Nuclide Chart

Transport and Packaging

Nuclide Mixtures

Nucleonica Scripting

Gamma Spectrum Generator

Gamma Spectrum Generator Pro

Cambio file converter

WESPA

Gamma Library

webGraph

» Marketplace

Logged in as: z

... web driven n

My Preferences Print Help New Brow

» **Position on Gamma Spectroscopy**
ITU Karlsruhe

Position to develop an Web S
(WESPA) for nuclear security...

» **Nucleonica Blog**

» **Nucleonica Standalone for Strahlenschutz**

The Federal Office for Radiation F
(Bundesamt für Strahlenschutz
ordered a standalone version of l
notebook computers "in the field"
no internet connection availab
version is based on the use of a

- Create, edit, download, delete your own libraries


... web driven nuclear science

[Applications](#)
[Data](#)
[Knowledge](#)
[My Preferences](#)
[Print](#)
[Help](#)
[New Browser](#)



Gamma Library

[Summary](#)
[Create/Edit](#)
[Sample Libraries](#)
[Options](#)

User defined gamma libraries

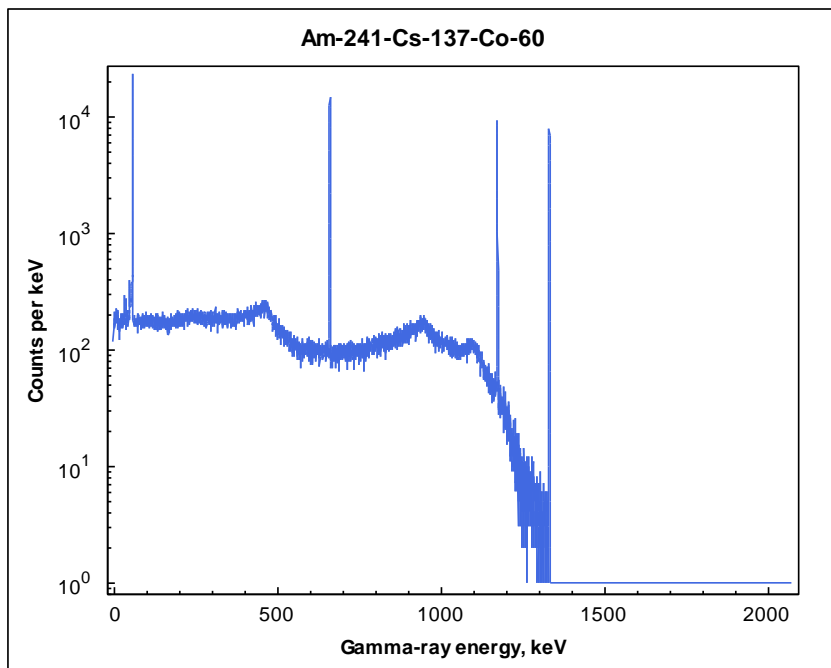
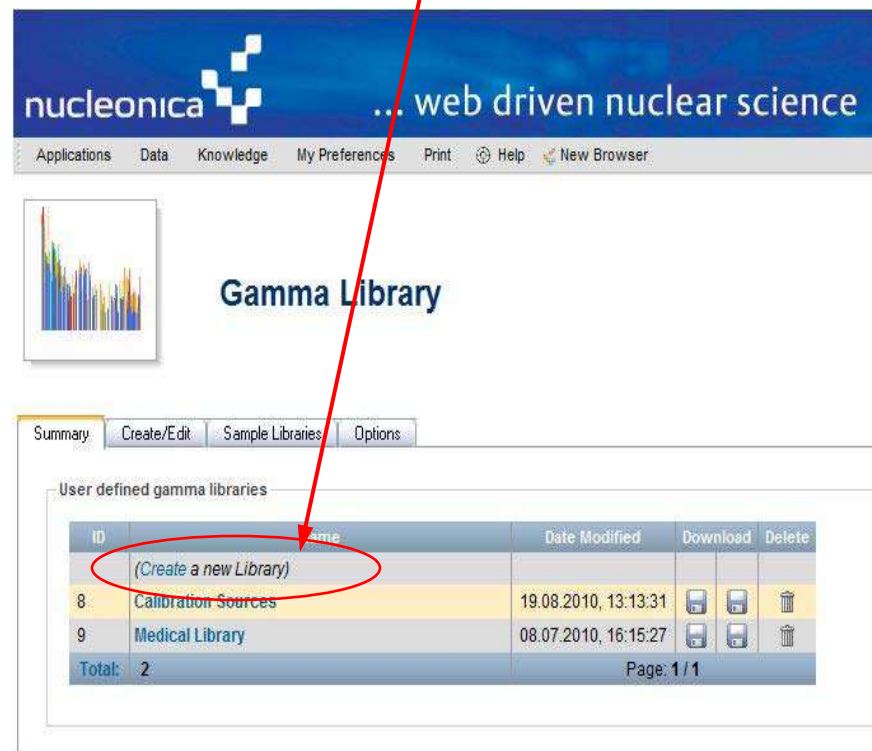
ID	Name	Date Modified	Download	Delete
	(Create a new Library)			
8	Calibration Sources	19.08.2010, 13:13:31	 	
9	Medical Library	08.07.2010, 16:15:27	 	
Total:	2			





Page: 1 / 1

Let's create a library for a set of calibration sources!

- ^{60}Co
- ^{137}Cs
- ^{241}Am

(Create a new Library)

ID	Name	Date Modified	Download	Delete
8	Calibration Sources	19.08.2010, 13:13:31		
9	Medical Library	08.07.2010, 16:15:27		
Total: 2		Page: 1 / 1		

Summary

Create/Edit

Sample Libraries

Options

Name:

Sources

Give a name to the library

Description:

Co-60, Cs-137 and Am-241 sources

Give a description

Current Chart: Karlsruhe

Am

241

☒ Consider daughters

Peak Selection

☐ All Peaks
☐ High resolution (HPGe)
☒ Low resolution (NaI)
☐ Deselect all

Emission type

☒ Gamma lines
☒ X-Rays

Am241

4.3E2 y

Add Nuclide

Save

Library Nuclides

Nuclide	Halflife	Delete
0 Nuclide	Page: 0 / 0	

Radiations from selected Nuclide

Energy	Emission Probability	Type
0 / 0 Peak		
Page: 0 / 0		

⇒

⇐

Daughters from selected Nuclide

Nuclide	Halflife
0 Daughter	Page: 0 / 0

Nuclide	Energy (keV)
Total:	0 Peak

Options

HPGe {

NaI {

Summary Create/Edit Sample Libraries **Options**

Database: Nucleonica

Min. branching ratio for daughters: 0.01

Peak selection: high resolution detectors

Min. Energy 30 keV

Max. Energy 3000 keV

Min. Emission probability 1 % of E.P. of strongest line

Min. Emission probability 1.5 % of E.P. of strongest higher energetic line

Peak selection: low resolution detectors

Min. Energy 30 keV

Max. Energy 3000 keV

Min. Emission probability 2 % of E.P. of strongest line

Min. Emission probability 5 % of E.P. of strongest higher energetic line

Energy range
(absorbers!)

Emission probability
settings for default
peak selection

Summary

Create/Edit

Sample Libraries

Options

Name:

Sources

Description:

Co-60, Cs-137 and Am-241 sources

Current Chart: Karlsruhe

Cs137
30.06 y

Cs

137

☒ Consider daughters

Peak Selection

☐ All Peaks
☒ High resolution (HPGe)
☐ Low resolution (NaI)
☐ Deselect all

Emission type

☒ Gamma lines
☒ X-Rays

Add Nuclide

Save

Library Nuclides

Nuclide	Halflife	Delete
0 Nuclide	Page: 0 / 0	

Radiations from selected Nuclide

Energy	Emission Probability	Type
0 / 0 Peak		
Page: 0 / 0		

Daughters from selected Nuclide

Nuclide	Halflife
0 Daughter	Page: 0 / 0

Nuclide	Energy (keV)
Total:	0 Peak

Select a nuclide

Consider daughters

Add Nuclide

Summary Create/Edit Sample Libraries Options

Name: Sources

Description: Co-60, Cs-137 and Am-241 sources

Current Chart: Karlsruhe



Cs 137

☒ Consider daughters

Peak Selection

- ☐ All Peaks
☒ High resolution (HPGe)
☐ Low resolution (NaI)
☐ Deselect all



Emission type

- ☒ Gamma lines
☒ X-Rays

Add Nuclide

Save

Library Nuclides

Nuclide	Halflife	Delete
55 Cs 137	30.1671 y	
1 Nuclide	Page: 1 / 1	

Radiations from 55 Cs 137

Energy	Emission Probability	Type
283.5	5.800e-6	Gamma
1 / 1 Peak	Page: 1 / 1	

Radiation

Nuclide	Energy (keV)	Emission
Total:	0 Peak	

Daughters from 55 Cs 137

Nuclide	Halflife
56 Ba 137m	2.55 m
1 Daughter	Page: 1 / 1

Click to add

Now let's see the real thing...
(Practical demonstration)

To make a library

first look at the spectrum

then guess which nuclides can be expected

(e.g. industrial, nuclear, medical, natural etc.)

Create a new library and start adding nuclides and energies

Create a library with the following nuclides and energies
(used in gamma-spectrometric measurement of
Uranium age and of ^{232}U content)

$^{232}\text{Th} / ^{232}\text{U}$

Ac-228

- 911.32
- 969.16

Bi-212

- 727.33

Pb-212

- 238.63

Tl-208

- 583.19
- 860.57
- 2614.55

^{238}U

Pa-234m

- 742.81
- 766.36
- 1001.02
- 1193.77
- 1737.80
- 1831.70

Pa-234

- 569.50

^{235}U

U-235

- 143.76
- 163.36
- 185.71
- 202.11
- 205.31

^{234}U

U-234

- 120.90

Bi-214

- 609.32
- 1120.28
- 1764.50